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# The Effects of Physical Practice, Mental Practice and Mental-Physical Practice on the Learning of Selected Basic Tumbling Stunts

Norma Boetel

# THE EFFECTS OF PHYSICAL PRACTICE, MENTAL PRACTICE AND MENTAL-PHYSICAL PRACTICE ON THE LEARNING OF SELECTED BASIC TUMBLING STUNTS

BY

NORMA BOETEL

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This thesis is approved as a creditable and independent investigation by a candidate for the degree, Master of Science, and is acceptable as meeting the thesis requirements for this degree, but without implying that the conclusions reached by the candidate are necessarily the conclusions of the major department.

J. C. 17 1965
Thesis Adviser — Date

July 19, 1965
Head, Physical Education Department — Date

# THE EFFECTS OF PHYSICAL PRACTICE, MENTAL PRACTICE AND MENTAL-PHYSICAL PRACTICE ON THE LEARNING OF SELECTED BASIC TUMBLING STUNTS

Abstract

NORMA BOETEL

Under the supervision of Associate Professor Glenn E. Robinson

The purpose of this study was to compare the effects of physical practice, mental practice and mental-physical practice upon the learning of selected basic tumbling stunts.

The following procedure was employed. The subjects chosen were 21 volunteer women from the required physical education classes at South Dakota State University. The 21 women were placed by a table of random numbers into a physical practice group, a mental practice group and a mental-physical practice group.

The experimental groups were given tumbling instructions by the author three times per week. The first meeting of each group was devoted to instruction and an explanation of the factors relative to the completion of the study. The second through the 15th meetings were spent practicing the stunts chosen for the study. The physical practice group physically performed each stunt daily for a six-minute period; the mental practice group mentally rehearsed the stunts for six minutes each; the mental-physical practice group physically performed the stunts one-half of the period, and the remaining time was spent mentally visualizing the stunt.

Every subject was rated on a tumbling test on the 16th and 17th day by a group of five judges. Each judge evaluated one specific point of a particular stunt.

As a result of the findings obtained during this investigation, the following conclusions appear warranted. The statistical difference between the physical practice group and the mental-physical practice group was not statistically significant. In comparing the combination of the physical practice and mental-physical practice groups with the mental group, a high statistical significance was found. This indicated that the use of mental practice for the acquisition of tumbling skills was inferior to the other two teaching methods.

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# Chapter I

# INTRODUCTION

## Reasons for Study

Physical educators should be constantly searching for new techniques and better teaching methods by which students may learn more effectively. Vannier and Fait[1] state:

> . . . there is no one best method which will assure triumphant success. The best teaching method is the one which gets the desired job done, providing it is a socially approved procedure.

Physical educators, whose basic concern is motor learning, are becoming increasingly aware of the importance of research relative to methodology employed in order to effectively teach skills involving complex movements.

In the past, it has been generally accepted that one learns physical skills best through physical activity. Consequently, little emphasis has been placed upon the use of mental practice. However, during the past few years, there has been a greater awareness of the values of mental practice in learning motor skills and the results of research are appearing in the literature. Lockhart[2] supports the use

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[1] MaryHelen Vannier and Hollis F. Fait, Teaching Physical Education In Secondary Schools, p. 50.

[2] Aileen Lockhart, "Do We Use What We Know?" Colloquium On Motor Learning, Central Association for Physical Education of College Women, Fall, 1964, p. 81.

of mental practice and its implications for the rehearsing and learning of motor skills. Lockhart states:

> Mental practice is now a subject of considerable current interest though a search of the literature shows that the possible beneficial use of conceptualizing practice has been recognized by a few individuals for at least three-quarters of a century. From the results of experiments, all of which show favorable though varying amounts of improvement by using conceptualization, it appears that our present teaching methods probably do not encourage individuals to place optimal demands on their capabilities. Mentally rehearsing an activity appears to elicit 'below threshold' response in the muscles which would be employed if the skill were actually, that is physically, rehearsed.

Many psychologists have conducted studies involving the use of mental practice and its relationship to the learning of the simpler motor skills. Physical educators have completed studies to determine the effects of mental practice on the development of muscular endurance, basketball fundamentals and swimming skills. An examination of the literature indicated that no studies had been done in which tumbling skills were taught by use of mental practice. The author believed that if mental practice or a combination of mental-physical practice showed no statistical difference, then either method could be used as an effective teaching procedure. Mental rehearsal does not require a large facility and if it should prove to be of value, it could be used in situations where overcrowded conditions exist. Such a procedure could also be employed as homework for the student.

The author hoped that the results of this study would have some application for teaching more complex motor skills and contribute to future studies.

## Statement of the Problem

The purpose of this study was to compare the effectiveness of three different methods of instruction (physical practice, mental practice and mental-physical practice) upon the learning of specific tumbling stunts.

## Limitations of the Study

This study was limited to 21 volunteer freshman women enrolled in the required physical education classes at South Dakota State University. Students who had previously participated in tumbling were excluded from the study.

No attempt was made to classify the subjects according to weight, height, intelligence or motor abilities.

The author assumed that the subjects, by a process of visualization, were actually rehearsing tumbling stunts during the mental practice period.

## Definition of Terms

### Physical Practice

In physical practice, the subject actually performed each one of the stunts physically after verbal instructions and demonstrations had been given.

Mental Practice

The definition of mental practice, expressed by Burns,[3] was accepted for use in this study.

> Mental practice may be defined as a procedure for practice whereby the student imagines herself going through movements necessary for performing a specific skill instead of actually performing the movements physically.

[3] Patricia Burns, "The Effect of Physical Practice, Mental Practice and Mental-Physical Practice on the Development of a Motor Skill," (M.S. Thesis, Pennsylvania State University, 1962), p. 4.

Mental-Physical Practice

Mental-physical practice refers to a combination of physical practice and mental practice. The time used in practice was divided equally between the two types of practice.

## Chapter II

## REVIEW OF RELATED STUDIES

In examining the literature, the author reviewed studies concerning the development of motor skills through the use of physical practice, mental practice and a combination of mental-physical practice.

In a study by Vandell, Davis and Clugston,[4] the authors selected thirty-six subjects from three levels: junior high school, senior high school and college freshmen. The equating of groups was done with a series of standardized tests which included intelligence scores, educational age, chronological age, motor ability and physique. The motor skills used in the study were dart throwing and free throw shooting. The junior high school students and college freshmen participated in the dart throwing skill and the senior high school students practiced free throws. Twelve subjects were selected from each of the three levels and these were subdivided into three groups of four subjects each. Group I, the control group, was tested with an initial and final test in each skill with no practice between the first and 20th days. Group II took the initial and final tests and had actual physical practice each day between the first and 20th days. Group III took the initial and final test and practiced mentally for the same 18-day period. On their final free throw shooting tests the

[4] Roland A. Vandell, Robert A. Davis, and Herbert A. Clugston, "The Function of Mental Practice in the Acquisition of Motor Skills," Journal of General Psychology, October, 1943, pp. 243-250.

control group improved 2 percent, the physical group 41 percent and the mental group 43 percent. After the final dart throwing tests were given to the junior high school students, group I decreased 2 percent in proficiency, group II gained 7 percent and group III gained 4 percent. When the college freshmen were tested in the same skill, the scores of the first group remained the same as the pre-test; however, the second group gained 23 percent and the third group gained 22 percent.

The authors concluded that in both skills the absence of either mental or physical practice resulted in no improvement; daily physical practice produced improvement in a particular skill; daily mental practice probably improved the performance of a motor skill; and mental practice appeared to be almost as effective as physical practice.

Although the groups were small, the conclusions from this study can be used as suggestions for future research in the fields of mental practice.

Twining[5] conducted a study to determine the difference

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[5]Wilbur E. Twining, "Mental Practice and Physical Practice in Learning a Motor Skill," Research Quarterly, December, 1949, p. 432-435.

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between physical and mental practice in learning the motor skill of ring tossing. Three groups composed of twelve participants each were chosen by random selection to practice a ring-toss experiment. The control group threw rings on the first and 22nd days; the second group practiced throwing rings for 20 days; the third group physically threw

rings the first and 22nd day and mentally rehearsed the ring-toss from the second through the 21st day. The improvement for groups two and three was statistically significant.

In a study completed by Halverson,[6] three methods were

[6] Lolas Halverson, "A Comparison of Three Methods of Teaching Motor Skills," (M.S. Thesis, University of Wisconsin, 1949).

compared to determine their effectiveness in teaching the one hand push shot. Sixty college women were divided into four separate groups. The first group (control group) had no instruction or practice; the second group (mental method) mentally practiced each period; the third group (demonstration method) physically practiced shots each period; and the fourth group (kinesiological method) analyzed the push shot and the amount of force needed, for the first few periods and then physically practiced shooting. Only those shots that passed through the basket without touching the backboard or rim were counted. She found that all three practiced methods proved effective in the development of this particular motor skill. The use of the mental practice method of learning was not as effective as actual practice in the development of the push shot. Halverson concluded that mental practice was effective and the results showed that there was improvement in actual performance.

Clark[7] suggested in his study that a combination of mental

[7] L. Verdelle Clark, "Effect of Mental Practice on the Development of a Certain Motor Skill," Research Quarterly, December, 1960, pp. 560-569.

and physical practice might be superior to other methods now being used to develop motor skills.

The skill involved in this study was the Pacific Coast one-hand foul shot. The 144 subjects used included varsity athletes, junior varsity athletes and novice performers. The subjects were equated for arm strength and intelligence by the paired-groups technique and then by chance drawing separated into a physical practice group and a mental practice group.

Each subject was instructed as to the shooting technique to be used. After instructions were given, the subject shot 25 consecutive practice shots. The instructions were repeated and each subject completed 25 additional foul shots. This constituted the initial score and a final score was obtained at the end of the experiment. During the experimental period of 14 days, the physical practice group shot five warm-ups and 25 shots for a daily test score. The mental group imagined shooting five warm-ups and 25 additional shots each day.

Each group showed significant gains with the t-test values being 10.5 for the physical group and 7.7 for the mental group. When practicing physically each day, the varsity group improved 16 percent, the junior varsity improved 24 percent and the novice group improved 44 percent. The mental group showed improvements of 15 percent, 23 percent and 26 percent, respectively. For the varsity and junior varsity groups, mental practice was almost as effective as the physical

practice; however, for the novice groups, mental practice was not as effective as physical practice.

Kelsey[8] reported in his study that the muscular endurance of

[8]Ian Bruce Kelsey, "Effects of Mental Practice and Physical Practice Upon Muscular Endurance," Research Quarterly, March, 1961, pp. 47-54.

a group of subjects practicing sit-ups was increased significantly through mental practice. He used three groups with 12 subjects in each group. Group I did sit-ups for 5 minutes on the first and 22nd day. Group II did sit-ups every day, while group III did sit-ups on the first and 22nd day and did sit-ups mentally on the intervening days. Although both the mental and physical groups improved significantly, he concluded that physical practice is much more effective in developing and increasing muscular endurance.

Clayton[9] conducted a study to compare the efficiency of

[9]Robert D. Clayton, "The Efficiency of the Land-Drill, Implicit Rehearsal, and Water Practice Methods in Teaching the Breast Stroke and Crawl Stroke To College Men." (Ed.D. Dissertation, University of Oregon, 1963).

teaching the breast and crawl strokes to college men by using a land-drill method, an implicit-rehearsal (mental practice) method and a water practice method.

Each group was instructed in the crawl and breast strokes by the three different methods for six minutes each period. The rest of the class was taught in the traditional manner.

Clayton found both the water-practice group and the land-drill group were significantly superior to the implicit-rehearsal group on two of the four modified tests used in this study. The water-practice group was significantly superior to the land-drill group on a third test.

He concluded that performers in a perceptual-skill motor task must have some previous knowledge of the skill before an implicit-rehearsal type of practice is significantly beneficial.

Burns[10] did a study using a control group, a physical practice group, a mental practice group and a mental-physical practice group. The subjects used were seventh graders, eleventh graders and college freshmen. The skill used in this study was dart throwing at a fixed target. Burns also wanted to determine the relationship between accuracy in dart throwing and in overhand softball throwing. The subjects were divided into groups by random selection. Each subject was given a target test on the overhand softball throw and then an initial dart-throwing test. The control group did no practicing between the initial and final tests. The physical practice group threw 30 darts a day and recorded their scores; the mental practice group threw 30 darts mentally each day and recorded the scores they thought they would receive. The mental-practice group alternated their practice procedure; on even numbered days, they practiced

[10] Patricia Burns, "The Effects of Physical Practice, Mental Practice and Mental-Physical Practice on the Development of a Motor Skill," (M.S. Thesis, Pennsylvania State University, 1962).

mentally and on the odd numbered days, they practiced physically. Each of the practice groups improved its accuracy significantly. The author also found a substantial relationship between accuracy in the overhand softball throw and accuracy in dart-throwing.

The studies investigated indicated that physical practice was superior in the learning of motor skills, but also suggested that either mental practice or mental-physical practice improved motor skills.

Morehouse and Miller[11] express their acceptance of mental practice as a method of learning in the following statements.

> Thinking about muscular performance has been shown to produce an increase in the tension of the muscles which would participate in actual performance. This phenomenon suggests that learning and perfection of a skill can proceed through reading and thinking about the technique of the event. Thus, a golfer during the winter season may improve his swing by studying texts written on the subject.

[11] Lawrence E. Morehouse and Augustus T. Miller, Physiology of Exercise, p. 69.

# Chapter III

# PROCEDURE

The general procedures used in securing the subjects, selecting and teaching the specific stunts and evaluating the performance of the subjects are presented in this chapter.

## Subjects

Twenty-one freshmen girls from the required physical education classes at South Dakota State University were volunteer subjects for this study. The freshmen class was surveyed to find subjects who had no previous tumbling instruction. Ninety-three of the 470 students questioned indicated no previous instruction in tumbling. A second survey was made of the 93 girls to determine whether or not they had ever practiced the stunts to be used in the study or could perform them. They were also asked if they would be willing to volunteer as subjects for this study. Of the 93 girls, 24 volunteered. Eleven from this group stated that they could not do any of the indicated stunts as listed on the questionnaire; six indicated that they could do a forward roll and seven could perform both the forward and backward rolls. A copy of the questionnaire used to determine tumbling experience is found in Appendix A.

## Experimental Groups

From this group of 24 girls, 21 were chosen by a table of random numbers to participate in the study. Nine girls were chosen

from the group of eleven who were unable to perform any of the stunts, and all of the six who could do only the forward roll were used as subjects. Six of the seven girls who could do both the forward and backward rolls were selected as subjects. An equal number of subjects from each group was placed by random selection in the physical practice, the mental practice and the mental-physical practice groups.

The author instructed each experimental group separately three times per week. The first meeting of each group was devoted to orientation and an explanation of the factors necessary for the successful completion of the study. The girls were informed that they were not to think about the stunts nor to practice them, other than at the times designated for their practice periods.

## Stunts Selected for the Study

In a discussion with a panel of experts and through a review of the literature, the forward roll, backward roll, headstand, forearm balance, cartwheel, roundoff, kip and forward limber were test items chosen for this study. Literature pertaining to tumbling revealed the following information: the forward and backward rolls require agility, flexibility and coordination; the headstand and the forearm balance require balance and arm strength; the cartwheel and roundoff require arm strength, agility, balance and coordination; the kip and forward limber require arm strength, flexibility and coordination. The author also chose the stunts mentioned above so that no

one single factor of agility, flexibility, strength, balance or coordination was predominant.

A training film was made to illustrate the correct performance of the stunts to be used in this study. The subject filmed was a skilled performer selected from the gymnastics team at South Dakota State University. This individual also demonstrated the stunts for the physical and mental-physical groups.

The purpose of the film was twofold; first, to aid in instructing the mental practice and mental-physical practice groups and secondly, to inform the judges of the correct procedures for evaluating the final performance of the subjects.

By investigating the literature, the author found agreement regarding the proper execution of the stunts. The directions given by the writers in the field of tumbling served as guides in formulating the instructions given to the subjects. Instructions concerning the methods to be used in performing each stunt appear in Appendix B.

## Physical Practice Group

Two mats 5 feet by 10 feet were used for the practice of each of the stunts. During the second meeting, the forward and backward rolls were taught. In teaching the forward roll, the group was given verbal instructions and shown the correct execution by demonstration. After instructions, each subject practiced 15 forward rolls in a period of six minutes. After the forward rolls were completed, instructions were given for the backward roll. The subjects then

practiced 15 backward rolls for a six-minute period. After completing a roll, each subject kept a tally on a sheet of paper to indicate the number of times the stunt had been performed and to enable her to keep an accurate record.

The headstand and the forearm balance were taught at the third meeting. Again, verbal instructions and a demonstration were given for the headstand. One-half of the group practiced the headstand for six minutes while the other half served as spotters for safety precautions. At the termination of the six minutes, the subjects who were serving as spotters practiced the headstand while the first group of performers became spotters. The forearm balance was taught and practiced using the same procedure.

The cartwheel and the roundoff were taught at the fourth meeting. The subjects practiced 10 cartwheels for six minutes after instructions and the demonstration had been given. After each girl had completed a cartwheel on each mat, she acted as a spotter for the girl immediately behind her. The roundoff was practiced following instruction and the demonstration with each girl practicing 10 roundoffs during the six-minute period.

During the fifth meeting, the kip and the forward limber were taught. Each stunt was practiced 10 times for six minutes after instructions and a demonstration. The procedure for spotting was the same as that used in practicing the cartwheel and the roundoff. If two spotters were needed, the next two girls in line aided the performer.

During each meeting, from the sixth through the 15th, all stunts were practiced for the same number of times as designated for the initial six-minute period. If any of the girls needed additional verbal instruction, it was given by the instructor throughout the practice period.

## Mental Practice Group

In the mental practice group, the stunts were presented in the same sequence as in the physical practice group. Instructions for doing each stunt were read; the film illustrating the correct procedure was shown and the students were told to visualize each particular stunt. For the forward roll, backward roll, cartwheel, roundoff, kip and forward limber, the subjects were told to mentally perform the same number of stunts as were required of the physical group during the same allotted time. The headstand and forearm balance were also practiced mentally in a six-minute period, but no specific number was required. The subjects were also asked to keep a tally on a sheet of paper each time they visualized the performance of a particular stunt.

During the second meeting, the forward and backward rolls were taught and mentally performed; at the third meeting, instructions for the headstand and forearm balance were given; the fourth meeting included instructions and practice on the cartwheel and roundoff; and during the fifth meeting, the kip and the forward limber were taught and practiced. From the sixth through the 15th meetings, after seeing the film and reading the instructions, the girls performed each stunt

mentally for six minutes for the designated number of times. Each girl in this group was permitted to read her written instructions at any time during the six-minute period.

Mental-Physical Practice Group

The subjects in this group received instructions in the same order as those in the other two groups. During the second meeting, the forward and backward rolls were taught and practiced both mentally and physically; at the third meeting, instruction for the headstand and the forearm balance was given; in the fourth meeting, the subjects learned the cartwheel and the roundoff; and on the fifth meeting, they were taught the kip and the forward limber.

In this group, after verbal instruction and demonstration, the subjects performed physically a specified number of stunts and the remaining stunts were performed mentally. The physical and mental practice periods were each three minutes in length. Before the mental practice, they were shown the film of the particular stunt to be learned that day. The stunts were practiced physically and then mentally on the second, third, fourth, fifth, eighth, ninth, 12th, and 13th practice sessions. After physical practice, each subject was instructed to visualize how she had physically performed her stunt. During the sixth, seventh, 10th, 11th, 14th, and 15th practice periods, the stunts were performed mentally and then physically.

## Evaluation of Subjects

Subjects from the three groups were tested on their ability to perform each of the stunts used in the study at the 16th and 17th meetings. The judging was done by five physical educators: two instructors from the Women's Physical Education Department at South Dakota State University; one male graduate assistant at South Dakota State University; one woman high school instructor; and the gymnastic coach at South Dakota State University.

Before the rating of the subjects, each judge studied the training films. The parts of every stunt to be evaluated were pinpointed by the author as the judges viewed the film. The judges were assigned to evaluate a particular portion of each stunt.

In rating the particular aspect of the stunt done correctly, the judge gave the subject a check mark and if performed incorrectly or not at all, no mark was given. Each girl was given two trials; the best of the two trials was recorded as her score for the stunt. These scores were tabulated and used to determine a final score.

The rating sheet used for the evaluation of the forward roll, backward roll, cartwheel, and roundoff was selected from a thesis written by McKay.[12] A rating sheet used for the evaluation of the headstand, forearm balance, kip and forward limber was devised by the author and approved by a committee of experienced tumbling personnel.

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[12] Michael Byrnes McKay, "Skill Evaluation Of Majors In Physical Education," (M.S. Thesis, South Dakota State University, 1964), pp. 44-47.

Each stunt had five points listed with the exception of the roundoff which had six. The rating sheet used for the evaluation of the tumbling skills is found in Appendix C.

# Chapter IV

# ANALYSIS OF DATA

## Introduction

The purpose of this study was to compare the effects of physical practice, mental practice and mental-physical practice upon the learning of selected basic tumbling skills. Data were collected, treated statistically and the results are presented in this chapter.

The 21 subjects were placed in one of three experimental groups by the table of random numbers. Test scores of the subjects in each of the groups were grouped together for statistical analysis.

## Analysis of Data

The statistical procedure employed for this study was the "analysis of variance" method as outlined by Garrett.[13]

[13] Henry E. Garrett, Elementary Statistics, pp. 169-178.

The F-ratio, at the one percent level of confidence, was accepted and applied. To be statistically significant, a F-ratio of 6.01 was necessary.

In comparing the data obtained between the mean scores on the final test among the physical practice group, mental practice group and mental-physical group, a F-ratio, with two and 18 degrees of freedom, of 7.2380 was found. Therefore, among the three groups, there

is a statistical significant difference at the one percent level of confidence. A summary of these findings is presented in Table I.

The physical practice group and the mental-physical group were compared to determine if there was statistical significance. The degrees of freedom were one and twelve. A F-ratio of 9.33 was necessary at the one percent level of confidence between the two groups. After applying the analysis of variance method, a F-ratio of .5142 was found between the mean scores on the tumbling test between the physical group and the mental-physical group. This showed no statistical significance. A summary of these findings is presented in Table II.

In comparing the combination of the physical and mental-physical groups to the mental group, a F-ratio of 8.18 was necessary to be statistically significant. A F-ratio of 13.9825 was found between the total mean score of the combination groups and the mental group. This is of high statistical significance. Such a high significance indicates that the mental practice group for the acquisition of tumbling skills is inferior to the other two teaching methods. Results of the statistical procedure are found in Table III. Raw scores for the performance of the subjects on the tumbling test appear in Appendix D.

## Summary

The data were analyzed to determine the effects of physical practice, mental practice and mental-physical practice on the development of certain tumbling skills.

Table I

Analysis of Variance Among the Physical Practice, Mental Practice and Mental-Physical Practice Groups

| Sources | SS | df | MS | F-ratio |
|---|---|---|---|---|
| Treatments | 706.5715 | 2 | 353.2858 | 7.2380 |
| Within | 878.5714 | 18 | 48.8095 | |
| Total | 1585.1429 | 20 | | |

Table II

Analysis of Variance For the Physical Practice and Mental-Physical Practice Groups

| Sources | SS | df | MS | F-ratio |
|---|---|---|---|---|
| Treatments | 34.5715 | 1 | 34.5715 | .5142 |
| Within | 806.8571 | 12 | 67.2381 | |
| Total | 841.4286 | | | |

Table III

Analysis of Variance For the Combination of the Physical Practice Group and Mental-Physical Practice Group Compared to the Mental Practice Group

| Sources | SS | df | MS | F-ratio |
|---|---|---|---|---|
| Treatments | 672.0000 | 1 | 672.0000 | 13.9825 |
| Within | 913.1429 | 19 | 48.0602 | |
| Total | 1585.1429 | 20 | 79.2571 | |

Applying the analysis of variance method among the groups, the F-ratio indicated a statistical significance. Using the F-ratio, it was found that the difference between the physical practice and the mental-physical practice groups was not statistically significant.

A combination of the physical practice and the mental-physical practice groups compared with the mental practice group indicated that the mental practice group was significantly inferior to the other two groups.

# Chapter V

# SUMMARY

## Problem

The purpose of this study was to compare the effects of physical practice, mental practice and mental-physical practice upon the learning of selected basic tumbling skills.

## Data

The subjects were 21 freshmen women from South Dakota State University. These women had no previous tumbling instruction.

The subjects were divided into a physical practice group, mental practice group and mental-physical practice group by use of the table of random numbers.

The physical practice group performed the stunts physically from the second through the 15th day. The first day was used for instruction and orientation for all groups. Each stunt was practiced daily for a six-minute period. On the 16th and 17th days, each subject was given the tumbling test. Each individual, in the mental practice group, was given instruction on the procedure to follow for mental practice. The stunts were practiced mentally for six minutes each from the second through the 15th day. The subjects in the mental practice group were tested on the 16th and 17th days. For the mental-physical practice group, a combination of mental practice and physical performance was used. Every subject practiced three minutes rehearsing

the stunt mentally and three minutes physically performing the stunt at each meeting. Their practices continued from the second through the 15th day. They were tested on the 16th and 17th days.

The data that were collected included the raw scores on the tumbling test as determined by the judges at the completion of the experimental period.

## Findings

The raw scores for each group were tabulated and the mean score was determined. The mean score for the mental-physical practice group was the highest. However, the difference between the mean scores of the mental-physical group and the physical practice group was not statistically significant. The mean scores of the mental-physical practice group and the physical practice group were combined and compared with the mean score of the mental practice group. The F-ratio was highly significant.

## Conclusions

The findings in this study would appear to warrant the following conclusions:

1. There was no statistically significant difference between the performance of the physical practice group and the mental-physical practice group.

2. The mental practice group was significantly inferior statistically to either the mental-physical practice group or the physical practice group.

## Recommendations

Based on the findings of this study, the following recommendations are made:

1. That a similar study be attempted using a larger sample.

2. That a similar study be undertaken using experienced tumblers.

3. That a similar study be completed using groups equated according to size, weight and intelligence.

4. That additional studies be undertaken to determine the effects of mental practice on physical skills that can be measured objectively.

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# APPENDICES

Appendix A

SURVEY OF TUMBLING EXPERIENCE

Name_____Section_____

Circle either YES or NO

1. Have you ever practiced the following tumbling stunts?

If all of the answers are "NO", circle here. NO

If you have had practice on some of the stunts, circle "YES" after each stunt.

| | | |
|---|---|---|
| Forward Roll | YES | NO |
| Backward Roll | YES | NO |
| Cartwheel from a standing position | YES | NO |
| Roundoff from a standing position | YES | NO |
| Headstand | YES | NO |
| Handspring from a stand position | YES | NO |
| Kip | YES | NO |
| Forward Limber (front limber) | YES | NO |
| Forearm Balance | YES | NO |

2. If you have circled "YES" for any of the above stunts, indicate whether or not you can actually perform the stunt.

| | | |
|---|---|---|
| Forward Roll | YES | NO |
| Backward Roll | YES | NO |

| | | |
|---|---|---|
| Cartwheel from a standing position | YES | NO |
| Roundoff from a standing position | YES | NO |
| Headstand | YES | NO |
| Handspring from a stand position | YES | NO |
| Kip | YES | NO |
| Forward Limber (front limber) | YES | NO |
| Forearm Balance | YES | NO |

3. Would you be willing to volunteer as a subject in a research project?

YES NO

Appendix B

INSTRUCTIONS FOR STUNTS PERFORMED IN STUDY

Forward Roll From A Squat Position To A Standing Position

1. Take a squat position with the knees together.
2. Place the hands on the mat in front of the body, about shoulders' width apart with the fingers spread and pointing forward.
3. Push the hips forward, shifting the weight from the feet to the arms. At the same time, bend both elbows equally and tuck the head.
4. Push off with the toes and land on the neck and shoulders.
5. Tuck tightly, keep the chin close to the chest and roll forward.
6. Grasp the shins, release, swing the arms forward and upward. Come to a standing position without pushing off from the mat with the hands.
7. Finish the forward roll with arms in the air, weight centered on the feet, and maintain your balance without stepping forward or backward.

Suggestions

1. The hands should be placed in front of the feet.
2. A tucked position is necessary. The chin must be close to the chest.
3. Keep the body close to the mat.
4. Push forward with the feet rather than upward.

5. Roll straight forward.
6. Do not come to a stand by pushing off from the mat with the hands.

Backward Roll From A Squat Position To A Standing Position

1. Take a squat position with the chin close to the chest.
2. Keeping the chin close to the chest, roll back onto the lower part of the back.
3. Place hands behind shoulders, fingers pointing backward, thumbs toward the neck, and elbows close to the body.
4. Continue rolling backward in a tucked position. As the back of the head touches the mat, place the hands flat on the mat with the thumbs in and fingers pointing in the direction you were facing at the start of the roll.
5. Push the shoulders off the mat by straightening the arms, lift the head upward, and bring the feet to the mat.
6. Give a final push with the hands and regain a standing position without stepping forward or backward, and raise the arms upward.

Suggestions

1. Keep the knees close to the chest, the head tucked and forward.
2. The body weight should be shifted equally to both hands.
3. Keep the body in a well-tucked rounded position.
4. Push hard with both hands equally.
5. The push should be backward rather than upward.
6. Land on the feet rather than the knees.

## Headstand

1. Place hands on the mat about shoulders' width apart with fingers spread and pointing forward.
2. Place the head as far forward from the hands as the hands are from each other.
3. Keep the weight on the front part of the head and the hands.
4. Keep the knees flexed, bring the feet up to the hands with small walking steps. Raise the hips over the shoulders and straighten the back.
5. Kick one foot up and then the other. Slowly extend the legs until they are straight and above the head.
6. Point the toes and keep the legs together.
7. Keep the weight evenly distributed on both hands and the head.
8. Balance in this position for three to five seconds.
9. To come down, flex the knees and hips, roll on back of the neck, and perform a forward roll onto rounded back.
10. Grasp the shins, roll to a standing position and finish with the arms upward.

### Suggestions

1. Form a triangle with the hands and your head on the mat.
2. Keep the weight on the fore part of head.
3. As the hips are raised, keep the legs close to the body.
4. Raise the legs upward with a smooth, steady movement rather than a quick, jerky motion.

5. To come down, push with the hands and tuck the head. Flex the knees and hips and perform a forward roll.

## Forearm Balance (Elbow Stand)

1. Get down on the knees and place both forearms on the mat parallel to each other, shoulders' width apart, palms down, thumbs in and fingers spread.
2. Walk forward to the arms so that the hips are raised as nearly vertical as possible.
3. Keep the head up and look straight ahead.
4. Kick one leg up to a position above the head into a balance and bring the other leg up to the first.
5. Extend the hips, keep the legs together, point the toes and arch the back slightly.
6. Balance in this position for three to five seconds.
7. To come down, bend the hips and lower both legs landing on the balls of the feet.

### Suggestions

1. Keep the head up.
2. Kick the legs up easily into the inverted position.
3. Arch the back only slightly.

## Cartwheel (Right)

1. Stand with the right side toward the mat with the arms horizontal to the mat.
2. Bend sideways and place the right hand on the mat a few inches in front of the right foot with the fingers pointing to the right side of the mat. Keep the elbows straight.
3. Kick the left leg upward, push off with the right foot, place the left hand on the mat shoulders' width apart and in a direct line with the right hand. Point the fingers of the left hand the same direction as the right hand.
4. Kick the right leg upward and travel in a straight line. Arch the back slightly, point the toes, hold the head up and keep the hips straight.
5. Swing the legs over the arms and land on the other side of the arms.
6. Place the left foot near the left hand with the toes pointing toward the left side of the mat. Place the right foot in line with the left at a distance approximately shoulders' width apart.
7. Push off with the right hand and then the left.
8. Straighten the body and bring arms out to the side. Face the left side of the mat when landing on the feet.

### Suggestions

1. Watch the mat.
2. Keep the elbows straight.
3. Keep the body traveling in a straight line.

4. Keep the head up, the legs straight and the toes pointed.
5. Make the arms and legs resemble the spokes of a wheel.

Cartwheel (Left)

1. Stand with the left side toward the mat with the arms horizontal to the mat.
2. Bend sideways and place the left hand on the mat a few inches in front of the left foot with the fingers pointing to the left side of the mat. Keep the elbows straight.
3. Kick the right leg upward, push off with the left foot, place the right hand on the mat shoulders' width apart and in a direct line with the left hand. Point the fingers of the right hand in the same direction as the left hand.
4. Kick the left leg upward and travel in a straight line. Arch the back slightly, point the toes, hold the head up, and keep the hips straight.
5. Swing the legs over the arms and land on the other side of the arms.
6. Place the right foot near the right hand with the toes pointing toward the right side of the mat. Place the left foot in line with the right at a distance approximately shoulders' width apart.
7. Push off with the left hand and then the right.
8. Straighten the body and bring arms out to the side. Face the right side of the mat when landing on the feet.

Suggestions

1. Watch the mat.
2. Keep the elbows straight.
3. Keep the body traveling in a straight line.
4. Keep the head up, the legs straight, and the toes pointed.
5. Make the arms and legs resemble the spokes of a wheel.

Roundoff From A Standing Position (Left)

1. Raise left leg forward, lean forward, and swing left foot to the mat.
2. As the weight is put on the left foot, whip arms down fast with the right hand ahead of the left hand. The left hand should point to the left side of the mat and the fingers of the right hand should point toward the left foot.
3. Push with the left leg and kick right leg up. Immediately kick the left leg up; when the legs meet, execute a half turn counterclockwise.
4. Keep the elbows straight and feet together in an inverted position.
5. Flex the hips, push off with the hands, and snap both feet down simultaneously.
6. Finish by coming to a stand. Land on balls of feet facing the starting position with the arms extended in front of the body.

Suggestions

1. Push hard from the mat with the left foot.
2. Bring both legs together in an inverted position.
3. Keep the elbows straight throughout the stunt.
4. Snap the feet down close to the hands.

## Kip

1. Lie down on the back.
2. Place hands on the mat above the shoulders with thumbs pointing toward each other. (place hands as for a backward roll.)
3. Keeping legs straight, raise them upward and roll backward bringing feet over the head. Keep hips flexed and knees straight throughout the movement.
4. The weight should be on the shoulders with the hands in contact with the mat.
5. Snap the straight legs upward and forward. As the legs are thrown upward and forward, arch the back and push away hard with the shoulders and hands.
6. Bring the feet under the body to land. After the push with the hands, snap the upper body forward.
7. Land on the balls of the feet, with toes pointed slightly outward and the knees bent.
8. Finish the kip with the arms raised overhead.

Suggestions

1. As the feet are brought over the head, immediately snap the legs upward and forward.
2. Arch the back sufficiently to get the feet under the body.

## Forward Limber (Front Over)

1. Place hands on the mat shoulders' width apart, fingers spread and pointing forward, and the elbows straight.
2. Keep the right leg straight and bring the bent left leg under the body.
3. Hold the head up.
4. Kick the right leg up over the head, push off from the left leg and bring it over the head drawing the legs together.
5. Point the toes, keep the back arched, and the head up.
6. Keep the arms straight throughout the stunt.
7. Over-balance the body and drop legs to the mat with the toes turned slightly outward.
8. Push with the hands, rock forward, and rise to a stand, keeping the arms overhead.
9. Keep the head back and the body arched throughout the performance.
10. Perform the stunt slowly and end with the arms extended upward.

Suggestions

1. Keep the head up.
2. Keep the elbows straight throughout the stunt.
3. The back must be sufficiently arched.

Appendix C

RATING SHEET FOR TUMBLING TEST

Name_____

Group_____

| Trials | |
|---|---|
| First | Second |

1. Forward Roll (squat position)

   Points to be checked:

_____ _____ a. Are the hands on mat with fingers pointed forward, knees between arms?

_____ _____ b. Is the chin tucked?

_____ _____ c. Is the neck and shoulders the first part of the body to touch the mat after the roll begins?

_____ _____ d. Is balance achieved at the end of the stunt without placing hands on the mat?

_____ _____ e. Was the stunt performed in a smooth and coordinated manner?

2. Backward Roll (squat position)

   Points to be checked:

_____ _____ a. Is the chin tucked?

_____ _____ b. Are the hands placed on the mat at about shoulder width apart?

____ ____ c. Is the body kept in a tucked position?

____ ____ d. Is the weight on the hands and arms rather than on the head and neck?

____ ____ e. Was the stunt performed in a smooth and coordinated manner?

3. Headstand

Points to be checked:

____ ____ a. Are the hands on the mat about shoulder width apart and the head as far forward as the hands are apart, to form a triangle?

____ ____ b. Are the legs straight and the toes pointed?

____ ____ c. Is the subject able to balance three to five seconds in the inverted position?

____ ____ d. Does the subject roll on the back of her neck and perform a forward roll to come out of the headstand?

____ ____ e. Was the stunt performed in a smooth and coordinated manner?

4. Forearm Balance

Points to be checked:

____ ____ a. Are the forearms on the mat approximately shoulder width apart?

____ ____ b. Is the head up and are the toes pointed?

____ ____ c. Is the subject able to balance three to five seconds in the inverted position?

____ ____ d. Does the subject bend her hips and land on her feet when coming to a standing position?

____ ____ e. Was the stunt performed in a smooth and coordinated manner?

5. Cartwheel (right)

Points to be checked:

____ ____ a. Is the right hand placed on the mat in line with the right foot?

____ ____ b. Is the head up and the toes pointed?

____ ____ c. Is the body traveling in a straight line?

____ ____ d. Are the hands and feet touching the mat in the following natural rhythm: right hand, left hand, left foot, right foot?

____ ____ e. Was the stunt performed in a smooth and coordinated manner?

6. Cartwheel (left)

Points to be checked:

____ ____ a. Is the left hand placed on the mat in line with the left foot?

____ ____ b. Is the head up and toes pointed?

____ ____ c. Is the body traveling in a straight line?

d. Are the hands and feet touching the mat in the following natural rhythm: left hand, right hand, right foot, left foot?

e. Was the stunt performed in a smooth and coordinated manner?

7. Roundoff (standing position)

Points to be checked:

a. Is a rocker step used?

b. Is the body turned a quarter turn as legs swing upward?

c. Is a quarter of a turn made as the arms push off the mat?

d. Is the head up and the toes pointed?

e. Are both feet landing on the mat together with a rebound?

f. Was the stunt performed in a smooth and coordinated manner?

8. Kip

Points to be checked:

a. Are the hands placed above the shoulders with the thumbs pointing toward each other?

b. Are the legs thrown upward and forward?

c. After the snap of the legs, is the body arched and are the feet brought under the body?

____ ____ d. Does the subject land on her feet with the arms raised overhead?

____ ____ e. Was the stunt performed in a smooth and coordinated manner?

9. Forward Limber

Points to be checked:

____ ____ a. Are the hands on the mat approximately shoulder width apart, with the fingers pointing forward?

____ ____ b. Are the arms straight throughout the stunt?

____ ____ c. Is the head held back and the body arched throughout the performance?

____ ____ d. Does the subject come to a standing position?

____ ____ e. Was the stunt performed in a smooth and coordinated manner?